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Modern methods of measurement

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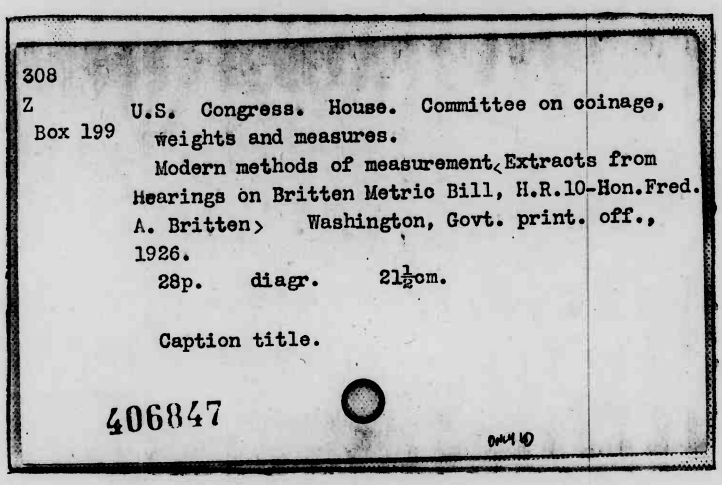

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MODERN METHODS OF MEASUREMENT

[Extracts from Hearings on Britten Metric Bill, H. R. 10—Hon. Fred A. Britten]

HOUSE OF REPRESENTATIVES,
COMMITTEE ON COINAGE, WEIGHTS, AND MEASURES,
Monday, February 1, 1926.

The committee met at 10 o'clock a. m. pursuant to call, Hon. Randolph Perkins (chairman), presiding.

The CHAIRMAN. The committee will please come to order. This is a hearing on H. R. 10, introduced by Mr. Britten, and referred to this committee, providing for extending the use of metric weights and measures in merchandising.

Mr. BRITTEN. I doubt, Mr. Chairman and gentlemen of committee, if there is another piece of legislation anywhere on "Capitol Hill" that could get back of it the galaxy of big men that this bill has behind it. It has behind it such men as General Pershing, Thomas A. Edison, and men of similar type and standing. I had a very nice letter from Mr. Edison Saturday saying he was sorry he could not appear before the committee in favor of this bill. He says he hopes the committee will give the bill favorable consideration.

Men like Samuel Vauclain, head of the Baldwin Locomotive Works, are behind this bill. Surely, that type of man would not be back of a bill of this kind unless it had some merit to it. I will read the names of a few of the men who are behind this bill and anxious to see it put in effect and a brief statement of what they have to say about it.

Henry Ford has said:

"We heartily approve of any steps toward the adoption of the metric system in our industry. It appears there is no better time than now."

Just at this point let me say that I go abroad every year, as no doubt many of you do. I am just as certain that the metric system is due to come into our system of business, sooner or later—may be not now, may be not next year, but sooner or later it must come; because it promotes efficiency and economy. I am satisfied from my travels abroad that it is the only system, and we will certainly adopt it. If England were to adopt it, we would follow; if we should adopt it, England would follow. They do not use our system. Our ton is different from the Canadian ton, and different from the British ton. Our gallons, quarts, etc., are different from theirs. Practically every country in the world has adopted the metric system of weights and measures excepting Great Britain and the United States. Surely it is time for us to do it.

John Bassett Moore, member of the World Court, said:

"I have long advocated the adoption of the metric system for the purpose of securing uniformity in the use of weights and measures throughout the world."

Charles W. Eliot, president emeritus, Harvard University, said:

"The adoption of the metric system by the United States would greatly reduce labor in trades because of the thorough decimal quality of the system, and would facilitate teaching of mathematics and applied sciences in schools."

Gen. John J. Pershing said:

"The experience of the American Expeditionary Forces in France showed that Americans were able readily to change from our existing system of weights and measures to the metric system. I believe it would be very desirable to extend the use of the metric system in the United States to the greatest possible extent."

Dr. L. S. Rowe, Director General of the Pan American Union, says:

"The United States loses business in Latin America because of persistence in using customary weights and measures in exports which are not understood and do not fit in with the industrial economics of the Latin Americans."

Dr. Charles H. Mayo, of Mayo Bros., physicians, Rochester, Minn., says:

"The metric system is now used generally by the medical profession and should be standardized for general use."

Samuel Vauclain, president of the Baldwin Locomotive Works, is at the head of one of the largest concerns in the United States, and yet he says:

"We could change to the metric system, or we could use both systems, without incurring any appreciable expense at the time. My opinion, however, is that were we all using the metric system, it would be much more convenient to the workmen, and our errors would be appreciably less than they are at present."

Why would our errors be appreciably less than they are at present? Because the decimal system provides the simplest means of calculation.

John Hays Hammond, well-known mining engineer, says:

"I am convinced from an intensive study of international commerce that the adoption of the metric system would greatly facilitate promotion of the export trade of America."

Mr. FITZGERALD. Mr. Chairman, I have to leave, and I would like to say that I will be very glad to put forth my efforts in behalf of this bill. I have practiced medicine for 35 years, where it is used a great deal in our work. I formerly did high-school work, and there I became in favor of the metric system, and I have ever since been in favor of it. To my way of thinking, it is bound to come. We may procrastinate, but as the students come out of our colleges they are going to take a stand for it. I would like, if I can, to come back to-morrow and be present at the hearing, but I will vote for a report of this bill first, last, and all the time.

Frederic L. Roberts, treasurer Metric Association, New York City, N. Y., says:

"As far as the system of weights and measures is concerned, the metric system is just a matter of dollars and cents. It all boils down to three main words, 'meter, liter, and gram. Then we have the principal divisions of the three. The 'milli' is the one-thousandth part of the unit, and the 'kilo' represents 1,000 units. We use the terms 'meter, liter, and gram,' and modify them by the terms 'milli and kilo,' depending upon the division or multiple, Here is the whole system in a nutshell:

Metric weights and measures

	Standard abbreviations
Length:	
10 millimeters =1 centimeter	10 mm =1 cm
100 centimeters=1 meter	100 cm =1 m
1,000 meters =1 kilometer	1,000 m =1 km
Capacity:	
1,000 milliliters =1 liter	1,000 ml =1 l
Weight:	
1,000 grams =1 kilogram	1,000 g =1 kg
1,000 kilograms =1 metric ton	1,000 kg =1 t

"This table contains all the weights and measures needed for practical purposes.

"We have before us a bill that is liberal in its form. As the Congressman has said, we attempt in this bill to cover merely two points. That is the buying and selling of commodities. Where a man comes into the open market and offers for sale a product, he will have to specify his goods in the metric system unless there is a reason for selling in the old system. The bill exempts the manufacturer. The manufacturer can continue in his own system. But we hope he will want to change over to the metric system after he sees the advantage of using it in buying and selling."

Melvil Dewey, president Lake Placid Educational Foundation, says:

"I have studied this matter closely ever since Hon. John A. Kasson, of Iowa, passed the permissive bill in 1866. The present bill has most carefully avoided every reasonable objection. I find that the negligible minority who still oppose either don't know the facts or have had no experience or in a few cases have some selfish interest to serve. Those who have experience and knowledge are enthusiastic for this very moderate bill.

"I was long in charge of all high schools in New York State and have had unusual opportunities to observe and consult with experts. We addle the brains and waste about a year of the school life of our children with the hodge-podge called compound numbers. Our direct loss in the computations of business is countless millions every year. A single railroad estimated that it cost them $50,000 a year that could be saved by using decimals only. Finally, it is one of the greatest handicaps to our foreign trade. The world has now adopted the metric system except England and ourselves.

"England long continued the old Julian calendar; they refused to adopt Arabic numerals generations after other countries, and somehow contrived to compute with the I, V, X, L. Our minds can not grasp the extent of the difficulty if we continued to use only Roman notation. The world is rapidly following our adoption of decimal currency, and I submit to your committee that it is a great wrong to America not to take this very moderate and unobjectionable step that will embarrass no one, so that we may have the priceless advantages of metric measures."

The CHAIRMAN. I have received a telegram from the National Association of Drug Clerks, which says:

"Fifty thousand drug clerks ask your help on Britten metric standards bill."

I also have a telegram from the National Wholesale Druggists Association, which says:

"National Wholesale Druggists Association is by resolution unanimously adopted in favor of adoption decimal metric units in merchandising after 10 years. Respectfully request hearing on Britten metric standards bill. Your favorable consideration of this request will be appreciated."

And a telegram from All America Standards Council, Aubrey Drury, director, saying:

"Seven Congressional Committees on Coinage, Weights, and Measures have reported in favor of adoption of metric standards by United States. No committee has ever reported adversely. Stone metric standards bill successfully passed two readings in the House of Representatives in Fifty-fourth Congress, then recommitted. We urge calling hearings on Britten bill in interest national progress and prosperity."

Mr. THURSTON. Have you any estimate of the amount of time that would be saved in business generally by the change from the fractional to the decimal system?

Mr. ROBERTS. Yes, sir. Dr. William Jay Schieffelin, president Schieffelin & Co., New York City, made a test in regard to the difference in the business world, as compared with the old system. The saving in writing is about 50 per cent; in weighing, about 45 per cent; calculating original formulas, 50 per cent; calculating increase in original formula, 50 per cent; pricing, 55 per cent; average saving of time, 56 per cent.

The CHAIRMAN. As to the possible conflict of the two systems, it might be of interest to the committee to hear read the testimony of Mr. Samuel Vauclain, president of the Baldwin Locomotive Works, given before a Senate committee in 1921. He said:

"We use both methods. We not only build locomotives entirely to the metric system, but we build other locomotives entirely to the English system. We have also built locomotives half and half—part of the locomotive designed in the metric system and the other half designed in the English system—with no difficulty whatsoever."

That has some bearing on the difficulty of the change.

The CHAIRMAN. He says:

"We have to manufacture for some countries to the English system, and we manufacture for other countries to the metric system. We probably make less errors when working to the metric system then we do when working to the ordinary English measures which we now use, or are supposed to use, as a standard."

Theodore H. Miller, works manager De Laval Separator Co., Poughkeepsie, N. Y., says:

"We used the English system in the manufacture of centrifugal machines from 1903 to 1910, when we changed to the metric system. Ever since that time all of our machine designs have been in the metric system, and the statement that I want to make is really to bear testimony of our experience and to refute the statements and the general belief that there are many difficulties and much expense involved in changing to the metric system.

"As a matter of fact, when we changed we naturally did not change the size of anything. We had been making centrifugal machines for many years. We believed these machines were properly designed and just because we called a size by some other name created no necessity for changing the size. We merely expressed it another way. So that we did not throw away or change any machine or any planer or any gages. All we did was to put metric dimensions on the drawings we had alongside of the English dimensions. That was a very simple thing. On some gages and measuring tools which we were using we did etch new figures, and on some we did not. If they were about to wear out, we did not bother with it. The gage was not changed, but only the expression of its size, so by

changing the drawings first and those things that were in most frequent use and later on all of them, and by making of new designs in metric dimensions, we were involved in practically no expense. We hear too many of these absurd statements that if we change over to the metric system we must throw away all of our machines, and we must throw away all of our tools and pictures and drawings. I think some go so far as to say that we will have to throw away the buildings because they are not made under the metric system. Those things are simply absurd. This metric system is extremely simple. We employ something like 1,400 people in our works. During the war we had as high as 1,800 and 1,900. We recruit them from the usual channels. People come in who know little or nothing about the metric system; but anybody that comes into our shop who can not learn all they need to know about the metric system in 15 minutes would not be fit to stay there anyway. They could not do any useful work for us. It is nothing in the world but the coinage system applied to weights and measures."

Joy Elmer Morgan, editor of the Journal of the National Education Association, Washington, D. C., says:

"I wish everyone could visualize the time it takes to teach our children these confusing systems, and the utter hopelessness of the 2,000,000 children in America trying to study and fix in their minds these units that we ourselves can not remember. With the metric system they would be taught just one thing, and they would automatically know all the rest. They would be taught the meter and its subdivisions. They would know that you could take one-tenth of that meter and square it and you would have the world quart, and that the world quart would weigh just 1 kilogram.

"To get a basis for comparison I picked up last night a French textbook, used in the French schools, and got a simple problem from it and expressed it in English and in metric terms simply as a means of visualizing to myself what the difference between a problem that a French school child faces and one that an American school child faces.

"We ask an American school child to calculate the volume of a cubical tank 6 feet 9½ inches each way filled with water. We ask the French school child to calculate the volume in meters and weight in kilograms of a cubical tank 2.07 meters each way filled with water. The French child puts that down as purely a decimal proposition. He works it out by 44 characters and manipulating those decimals. The English child in order to get that answer, or the American child, has to write down and add up and divide and work out 242 characters, multiplying by that plan the possibility of error in writing the wrong characters, and adding that much to his labor. The first child calculates that volume in cubic meters, and then knows that a cubic meter contains 1,000 liters. He simply moves his decimal point over three places, which he has already learned to do in the decimal system.

"I do not think it has been sufficiently emphasized that throughout the entire civilized world all of our mathematical calculations are based upon the decimal system. It is no theory; it is a fact. I have learned both systems. I have taught both systems. When I went into high school we had to study sciences. In a single lecture of 40 minutes they told us all about the metric system, and we could use it and did use it and did it easily.

"I think this is a heritage every adult owes to a child. If there is anything we can do to make his job easier, we should do it. As the great patriots 150 years ago worked to give this

country political freedom, I wish that the Sesquicentennial in Philadelphia could give the American school child freedom from these out-of-date antiquated systems of weights and measures, so that he could have time to study subjects that are really much more beneficial."

Hugh Miller, dean of George Washington University, member of American Society of Engineers, member American Society of Civil Engineers, fellow of American Association for the Advancement of Science, member of council of Society for Promotion of Education, member of National Council of Education, member of Washington Society of Engineers, member of Princeton Engineers' Association, graduate of Princeton, class of 1901, says:

"The passage of this bill will introduce the metric system. I would like to make this point very clear and emphatic, that the passage of this bill will introduce the metric system and will automatically set in motion all the educational machinery of the country so as to have the people prepared for its fullest use by 1935.

"Let me give an example very similar to the example given by the last witness. Engineers frequently have to figure the weight of structures, such as a tank on top of a building, a water tank. Take, for example, a 200,000-gallon tank. We have to compute how much it weighs. That would be done by arriving at 200,000 times 62½, or 7.48 by the English system. If I had to do it in long hand it would take quite a while.

"In the metric system, if we had a 200,000-liter tank we would know how much it would weigh. There is no conversion necessary. It would weigh 200,000 kilograms. You would know that right away, because 1 liter of distilled water weighs 1 kilogram."

Dr. Harvey W. Wiley, Washington, D. C., says:

"In my medical career I realized the difficulties of the system of measuring drugs then in vogue and still somewhat in vogue as to mistakes which might prove fatal, and the difficulty and the complications in the mixture of drugs which were very severe from a mathematical point of view. I finished my career in scientific study, and had thereby acquired a preference for the metric system, which was, I think, based upon sound principles.

"The Congress of the United States has never legalized any system of weights and measures in this whole country except the metric system. That was done many, many years ago, in 1866. Congress of the United States passed a law making the metric system of medicine compulsory in all the medical branches of the United States Government, and that law went into effect in 1895, and has never been repealed. Thus the Congress has already recognized the superior merits of the metric system, so-called, in medicine.

"I served as president of the Pharmacopœia Convention during the decennial period from 1910 to 1920, and as president of that convention assisted in the making of the pharmacopœia, which has been the recognized authority up to the present time, and that pharmacopœia, for the next decennial period, is just about to come in. In the pharmacopœia we place the metric system first of all for our practicing physicians and allow the old system as a second choice."

George F. Kunz, president Museum of Peaceful Arts, New York City, says:

"A few years ago I was present one evening when there were 10 or 15 nationalities represented at a musicale. They were

friendly and one said, 'Can you play that?' Another, 'Can you play that?' They took a sheet of music and every nationality could play that sheet of music. We look at musical men as being long-haired artists, do we not? They have the only universal language to-day by which they can understand each other. If we had a universal language, it would do more toward world peace than anything else.

"Forty per cent of the inhabitants of New York City were brought up on the metric system.

"Madam Montesorri took a lot of children in New York off the streets, from 5 to 10 years old, and inside of half an hour they knew the metric system."

Miss Edith M. Barker, of the American Home Economics Association, says:

"I am speaking from the standpoint really of the woman buyer. I am a home economist writer and buyer and have had a great deal of experience from the point of view of the woman buyer.

"I feel it would be perfectly possible to educate women to use the metric system and at the same time educate her in buying if we had the cooperation of the schools, of the magazines and newspapers, and by cooperation in the newspapers and magazines; I mean not only in the editorials but in the advertisements. The advertisements are great educators. You know 10 years ago no one knew what a vitamin was, but to-day vitamins figure in conversations along with calories. I think the women of to-day are interested and would be interested if this could be put up to her in a new way and shown to her that it would be a help to her in her buying rather than a hindrance."

RESOLUTIONS ADOPTED BY NEW YORK STATE FEDERATION OF WOMEN'S CLUBS

Whereas it is generally agreed that the present system of weights and measures now in use in this country is a hindrance to education, industry, and world trade, and a handicap in the ordinary business of daily life; and

Whereas statistics show that a great amount of time and consequently money could be saved in the instruction of every school child if the decimal-metric system of weights and measures were substituted for our present unsystematic method; and

Whereas the metric system is in use in all civilized countries except Great Britain and the United States; and

Whereas our early statesmen discarded complicated English currency and adopted the decimal dollar and cent because of its simplicity and convenience; and

Whereas the decimal metric system of weights and measures is equally desirable with only three units, meter and liter and gram, decimally divided like our dollar; and

Whereas the metric system is used to a very great extent in the United States in science, in many factories, in the jewelry and optical industries, in measurements for the radio, in sports, in many hospitals, in foreign trade, in many Government departments, etc.; and

Whereas it has been indorsed by leaders in every field, as Charles W. Eliot, Andrew Carnegie, Thomas Edison, Theodore Roosevelt, General Pershing; and

Whereas the gradual introduction of the metric system in this country (exactly as it has been successfully introduced in 55 other countries) is perfectly feasible: Now, therefore, be it

Resolved, That the New York State Federation of Women's Clubs indorse legislation in Congress for the Nation-wide adoption of the metric system of weights and measures.

Presented by Eleonore F. Hahn (Mrs. Otto Hahn), chairman, first district, New York State Federation of Women's Clubs.

Indorsed by Katherine D. Blake, vice chairman, committee on education, New York City Federation of Women's Clubs.

Fred J. Miller, New Hope, Pa., says:

"Now, as for me and my competence to speak on the metric system, I may say that I have been raised, so to speak, in machine shops. As a boy I went to work in a machine shop, served an apprenticeship and served in various capacities up to the general manager of five factories employing 5,000 people.

"I was commissioned a major in the Army during the war and was stationed at Rock Island, in the manufacturing department, and afterwards at the Bethlehem Steel Works, in connection with manufacturing armament for the Navy. I afterwards became engineer member of the Water Power Resources Board of the State of Pennsylvania, then a member of the Public Service Commission of the State of Pennsylvania, and I am past president of the American Society of Mechanical Engineers, which is the leading mechanical society of this country, having about 18,000 members. I mention that simply to show my familiarity with mechanical matters. I do not know much else but mechanics.

"Now it happened that among other things I have done, I was for 20 years editor of the leading machinery journal of this country, and that led me to travel throughout this country in the machinery building establishments, and abroad also. I have been abroad twice, looking over establishments there. I was first mildly interested in the metric system because I found it in use in a number of American establishments when I visited them. I asked them how they liked it and how it worked, and I never received an adverse opinion or unfavorable opinion about it. I found it much simpler and much less liable to mistakes."

METRIC SYSTEM IN EXPORT TRADE

[Report of Samuel W. Stratton, former Director of the Bureau of Standards, now president Massachusetts Institute of Technology, on the use of the metric system in export trade]

I. Answers to Specific Questions

1. (A) WHAT PROPORTION OF MANUFACTURERS HAVE ADOPTED THE METRIC SYSTEM IN PREPARING GOODS FOR EXPORT?

To give exact figures would require a census of manufacturers. The proportion is large if those firms alone are considered which seek export business. Most of such firms use the metric system to meet the need for intelligible catalogues and price lists, to meet in many cases also the insistent demand for products in metric sizes, and finally to satisfy the customs requirements of the country concerned. The enterprising exporter meets these requirements as fully as possible. The factories are conservative and require education, since they are not brought directly in such close touch with foreign needs. Exporters most earnestly favor the increased use of the metric system in the development and holding of foreign trade.

The following examples are given as a few typical of the large number of manufacturers who are already using the metric system, in some cases for both domestic and foreign trade:

American Locomotive Co.

Baldwin Locomotive Works (metric orders for locomotives, etc., are filled by the use of the metric system throughout).

Brown & Sharpe (supplies fine tools, gages, measuring tools, made to measure in metric units).

Pratt & Whitney (metric gages and standards).

Waltham Watch Co. (fine watches, metric system used throughout their works).

The Standard Tool Co. (twist drills, reamers, taps, chucks, milling cutters, and special tools).

Morse Twist Drill Co. (supplies lines of metric drills, etc., at same prices as those in customary units).

Bausch & Lomb Optical Co. (optical instruments and microscope supplies made up and sold in metric units).

Eastman Kodak Co. (supply metric focus scales on their cameras).

Lufkin Rule Co. (measuring tapes and rules, full line of metric tapes at same prices as those graduated in feet).

International Exporting and Importing Corporation (pack all exports in metric sizes).

Keuffel & Esser Co. (draughting instruments, and supplies, lines of metric sizes).

Powers-Weightman-Rosengarten (drugs and chemicals sold in metric containers when so ordered).

Library Bureau (library equipment and supplies, especially index cards and cabinets for libraries and offices).

L. S. Starrett Co. (fine mechanical tools, full line of metric sizes, and of tools graduated both in metric and inch sizes).

This list might easily be extended almost indefinitely. A characteristic of even the more conservative manufacturer is his readiness when he really appreciates the situation, to put out rather full lines of metric products side by side with his regular line. It is striking that the availability of the metric products has been advantageous in many cases in domestic trade.

1. (B) HAS THEIR EXPERIENCE WARRANTED AN EXPANSION OF THIS POLICY?

With the growing use of the metric system at home and abroad, it is clear that not only is the policy of extending its use in manufacture warranted, but it is essential. A well-informed exporter said recently: "Our foreign trade can never be satisfactory until we meet the requirements of the foreign market." The same exporter attributed the difficulty in securing and holding foreign trade to our failure to use weights and measures intelligible to and usable by the foreign countries concerned.

Experience has shown the wisdom of giving metric equivalents in catalogues and price lists; customs regulations in metric countries already requires metric marking of shipments; package goods in many lines are being put up in integral metric sizes. Common sense in shop practice quickly adapts itself to new methods when metric orders are to be filled—suggesting the easiest way to make the material to metric sizes, either directly by using metric tools and metric measures, or indirectly by translating the sizes into English units and using English tools and English measures. The latter method is open to all manufacturers with existing equipment. The direct method of working with metric tools is to be preferred. For example, a large and well-known locomotive works handled an order for 100 locomotives, all dimensions of which were in metric measure. Not a dimension was translated, and from drawing room to assembling, the job was handled in the metric system. The executive in charge of the works stated to a Government representative that—

"The adoption of the metric system for this and other orders did not cost a penny extra. We already work to all kinds of

scales, even in our English units, and the metric unit simply added an extra scale. Our mistakes were fewer with the metric order and the loss for rejects less than on our regular line. The use of the metric system was indeed found to be easier in many respects, and we fill all orders for metric sizes of products in the metric system. That is the common-sense method and is no trouble at all."

A member of a large firm of exporters handling canned goods stated positively:

"The change over to the metric system in our line would not cost a cent. At the end of the season, when my stock of cans is used, I could make the change easily and without expense."

This same exporter stated that the metric system should be adopted as soon as possible. His recent tour of South America had convinced him absolutely of the necessity and desirability of this change. The question whether an increased use of the metric system is warranted should be answered emphatically in the affirmative.

2 (A) WHAT ARE THE CHIEF OBJECTIONS TO SUCH ACTIONS?

Certain objections have been suggested, among which five may be cited. These relate mainly to cost and anticipated difficulty and confusion.

(1) It is said that if the metric system is used, it would mean two systems instead of one. The fact that two systems are already in legal use in this country answers this objection. The time has passed to raise this point. The law of 1866, making the metric system legal for all purposes has resulted in a greatly increased use by manufacturers, many of which carry lines of products in both systems, one for domestic, the other for export business. It may be added that the use of the metric system for domestic trade is increasing.

(2) The cost is a second objection. The fact stated previously that firms opposed to the general adoption of the metric system already carry metric-sized products for export indicates that it is profitable to do so. Some of the most conservative firms have for many years carried such lines of metric products side by side with those based on the customary units. The experience is that the prices of such metric products are no higher than the corresponding English-sized products, especially measuring tools. A casual examination of tool catalogues is convincing on this point. An experience such as the manufacture of French locomotives in a Philadelphia locomotive works using metric measures for this purpose shows how by intelligent handling any anticipated expense can be minimized or even avoided.

(3) It is claimed also that much of existing information now in the workman's mind in customary units would be less useful when working in the metric system. The sufficient answer to this is that approximate equivalents easily learned permit ready translation during the short period needed to acquire the new knowledge. However, modern technical data cover too large a field and handbooks and tables are too widespread to require that large amounts of numerical data should be memorized. It is in fact a question whether this is not to some extent a harmful practice, since numerical data are subject to change as more exact values are obtained by research, the fact that even engineering handbooks quickly become out of date on account of such changes is conclusive on this point. However, any loss from this cause would be more than compensated by the gain in availability of foreign technical data which are now a sealed book to those unacquainted with the metric system.

(4) A common fallacy is that standard sizes now in customary units would have to be changed. Where a size is the most efficient size, it need not be changed. Where it is not the most efficient size, it should be changed whether we change our system of measures or not. Any efficient size may be retained and can be expressed equally well in metric or customary units or in both, as is often done. A vital consideration, however, is that in order to be permanent, standardization must be international, and since the large majority of the countries are using the metric system, and this is the only international system, world standardization can best be done in metric units.

(5) Some have felt that community of interest with England dictates that we retain the English measures. As a matter of fact, England long ago abandoned the troy pound, and we are using a gallon and a bushel which England discarded decades ago, so that in respect to all dry measures, all liquid measures, and the ton weight, American practice already differs from English practice. It is as difficult for an American exporter to adapt himself to these measures in trade with England and her colonies as it would be for an American exporter to adapt himself to the needs of metric countries. Furthermore, the American bushel has values varying from State to State in such confusing diversity that wholesale grocers and commission merchants have been driven to sale by weight. The fact that English exporters are using the metric system in exports is an equally cogent reason why we should do the same.

2. (B) ARE CERTAIN LINES LESS ADAPTABLE THAN OTHERS?

All products naturally can not be produced in metric units with equal facility. Textiles and machines appear to some to be less adaptable. However, in both of these lines our export business shows that even in metric countries there is some disposition to accept current products where quality and price outweigh the system in which they are manufactured. Many years ago the Waltham Watch Co. found it convenient to adopt the metric system in their large plant for all purposes. So much for delicate mechanism. Manufacturers of lathes are furnishing metric lead screws and change gears, and in small tools meeting the demand for metric sizes. Then in heavy machinery, such as that found in the locomotive, an example has just been cited showing that such manufacture is entirely profitable. In fact, notwithstanding adverse views of some as to the full use of the metric system, they are to-day making, and have been making for years, many products which meet the demands of metric countries giving such lines in their American catalogues. These include taps, dies, screw-thread standards, gages, calipers, rules, which are being made to metric sizes. This was done without suggestion from the Government or any consideration other than profits. Since these are the lines of products from which the greatest difficulty was apprehended, it is quite clear that the more adaptable lines can readily meet the needs of export business.

If manufacturers and exporters in metric countries can prepare products acceptable in the United States and England with their different standard of measures, it is incredible that America can not reciprocate to meet the essential demands of metric countries by such reasonable use of metric terms in making or marking our products.

In such industries as experience difficulty, and there may be some, in using the metric system fully, it is believed that the suitable degree of conservatism will be compatible with the many industries where the metric system is more easily adopted. The canned-goods exporter quoted above stated that, to meet competition, he is constantly making changes in cans greater than that involved in adopting metric-sized cans.

In contrast to some of the above industries may be mentioned a large group of industries like grains, flour, chemicals, drugs, paints, and similar lines, which involve no change in manufacturing equipment, but only a change (where that has not occurred) in the size of the container used. Flour, for example, is packed for Latin-American export trade in integral numbers of kilograms. A prominent cement-manufacturing company in a letter signed by its president, under date of October 27, 1915, states:

"All our business with South America is done on a basis of barrels of 180, 150, 120 kilograms, respectively. In other words, in our export business with South America the kilogram is the measure rather than the pound. This is true of all the cement that is exported from the United States. All manufacturers exporting Portland cement from the United States to South America are using the metric system as a base just as we are."

It should be stated in this connection that products which can not be made to metric sizes must be sold as they are or the foreign trade in them must be adandoned. This fact, however, should not in the least degree militate against the full use of the metric system in all other lines where those units can be used to the extent that foreign trade demands. In the textile industry, for example, one outspoken writer—not a manufacturer—speaks disparagingly of the metric system. It is important to guard against undue weight being given to such opinions when considering other lines of manufacture or sale. The large export business of the textile industry seems to indicate that the measures used in the factory are not involved to the same degree as in other lines. Usually all that is needed is that goods be sold by the meter in length, which is just as easy to do as by the yard. Furthermore, the widths as given in inches are not exact when bought and an expression to the nearest centimeter would probably be nearer or as near the correct length as is at present given in inches.

While certain lines are less adaptable than others, it is quite clear that few, if any, firms will refuse to fill orders received in metric terms. They may try to fill the order in the nearest English equivalent, but more progressive and farsighted firms will look to the future and endeavor to meet as fully as possible the demands of their present and prospective customers.

3. WHAT WILL BE THE EFFECT UPON THE SCALE AND TOOL TRADES OF ANY SYSTEMATIC MOVEMENT IN THIS DIRECTION?

The effect will be, as in all considerable innovations, to awaken a measure of opposition, not in the sales departments but among the older workers among whom set practice has removed the fine edge of enterprise. Some well-meaning men have urged that English measures were working well enough and a change would be all but impossible. Yet the very firms concerned are using the metric system for their own profit. No more could be asked. The extent to which advance should be made toward the complete adoption of the metric system is the only question seriously discussed to-day, since its partial adoption is an accomplished fact. The metric system is coming into greater use daily in the United States, so that we have already two systems not only in catalogues but in the factories which make and pack. There is not a scale or tool maker of any note to-day who is not making scales (weighing or measuring) or tools working to size such drills, reamers, etc., who is not already making such products also to the metric sizes.

The effect will next be to awaken the ingenuity of the younger trained technical men in meeting the demands of the world market. Attention to the world units of measurement

will in turn awaken their desire to assimilate the best in foreign practice in order to improve products and methods of manufacture. Newspaper and technical literature mention metric units hundreds of times more frequently than a few years ago. This is largely due to more rapid news service which precludes translation of units, to the better education of our technical and general readers in the knowledge of the system, and to the introduction of scientific methods in industry, which bring with them the metric units in which they were developed. The younger trained technical men may be trusted to meet the problems in using metric units. The change is naturally one of magnitude, but changes more sweeping have engaged most of our industries within a generation. The whole process of making electric lamps, for example, has been changed three times within a generation; one railroad has been rebuilt three times during the lifetime of men now living; and the practice of generating and distributing electricity is changing so rapidly that it is difficult to keep apace with it. In other words, industrial changes which in many cases mean discarding and scrapping expensive manufacturing equipment are being made in almost every line, and it is considerd profitable to do so. No less in the scale and tool trades will a movement toward the international system of measures awaken the spirit of enterprise, and instead of confusion it will probably result in a new era in those industries.

4. OUGHT WE RECOMMEND THE COMPULSORY INSTRUCTION IN OUR SCHOOLS IN THE METRIC SYSTEM, OR MIGHT IT BE LIMITED TO HIGH SCHOOLS?

In metric countries the common units of the metric system are familiar to the children before they enter the lowest grades of the schools, as dollars, dimes, and cents are well known to our own first-grade children. The question of teaching the metric system is important. It is already taught in the high schools, since scientific instruction can not be given without the use of metric units, so the last part of the above question, No. 4, answers itself. The only question which remains is whether it should be taught in the lower grades.

The metric system, especially in its units of length, area, and volume, is a graphic illustration of our system of numbers, and the use of these units even in the lower grades would be valuable merely as a graphic illustration of arithmetical relations. If our coinage were also taught, the three decimal systems—money, measures, and numbers—could be taught together, mutually reinforcing each other. The "customary" weights and measures might profitably, on account of their complexity, be deferred. The practical gain in giving all school children training in the decimal money, measures, and numbers together would be inestimable.

It need hardly be added that the instruction in the metric system in the early grades should be limited strictly to the system itself and not complicated as often done by translating units from one system to another. Such translation is the only difficulty experienced, and this difficulty is only on account of the complexity of the English system. Each common metric unit should be learned from a concrete object having the unit size or unit weight, and measurements can be made by scholars at a very early age, and the results expressed directly in metric units. Its terms are so self-defining that the tables need not be memorized, but can be made up at will. The logical character of the metric system makes it of great educational value as a mental tool. The need for translation from one to

the other is very small and disappears as soon as the metric system is made the common one. The mental economy of the metric system, it has been shown, is inestimable.

II. Practical Suggestions

1. Serious obstacles to foreign trade

The reasonable use of the metric system to the extent demanded by export business will break down three serious obstacles to trade extension in Latin America (where the metric system has been adopted and is in use). These three obstacles which will be largely removed are (*a*) the nonusability of nonmetric products in metric countries (in some cases); (*b*) ignorance of foreign market conditions, opportunities, and statistics which to the nonmetric business man are not well known; and (*c*) the ignorance in those foreign countries as to our available products and their units and prices, owing chiefly to inability on the part of the great mass of possible buyers to readily understand our measures.

2. Willingness to handle metric orders

The example of many manufacturers in handling metric orders has solved the shop problem of making many of such products directly in the metric system. Any manufacturer who through ignorance, fear of confusion, or lack of enterprise is unwilling to attempt to meet the requirements of foreign trade should confine his attention to our domestic trade. He should not, however, be permitted to retard the development of foreign trade by his inertia or indifference to the metric system, which is now the legal system in 56 of the countries whose trade we seek. Still less should his opposition or his opinion have consideration in comparison with the judgment of those who seek earnestly and by all possible means the extension of trade with the metric countries. The subject is too important to be decided by any except those who are either using the metric system or willing to do so to the full extent that the export trade demands. Recent experience has shown that many of the manufacturers can successfully make the change without undue difficulty.

3. Existing modes of use of metric system in export trade

In using the metric system to promote export trade with metric countries, common sense should take the practical turn of deciding how far its use is profitable, and go at least that far. For example, the present modes of use of the metric system in export trade (and incidentally meeting growing metric demands in domestic trade) may be grouped as follows:

(a) Complete use of metric system in designing, making, and selling.

(b) Price listing in metric equivalents (to enable the foreign buyer to understand quantities and prices).

(c) Packing products in units of metric size (this can be done in cases like flour, oil, and so forth, and does not involve change in manner of making).

(d) Labeling metric equivalents on the unit packages the contents of which may be put up in customary units.

(e) Stenciling shipping cases for export with the quantities in metric units to meet the customs requirements in metric countries (the metric countries are 56 in number).

(f) Filling metric orders with the regular sized packages or products, merely billing in metric terms to enable the buyer to check price.

From a strict business view, sufficient use should be made of the above-described modes to meet the essential requirements of the market we seek. All of the uses described will be found among our exporters. Naturally the more complete the use the greater the gain, for exporters will agree that the more complete the use of the metric system the easier it is to obtain foreign orders. From this point of view no argument is necessary.

4. Adequate facilities and aids in using the metric system

Aids and facilities for using the metric system in promoting export trade are available as never before. Metric sizes of material, metric gages, metric measuring instruments, are increasingly accessible, as indicated by the catalogues. So, too, metric data are found everywhere, in handbooks, tables of equivalents, charts, and rules. The Bureau of Standards has three publications—a pamphlet descriptive of the metric system, a graphic chart of the system, and a book containing definitions and tables of equivalents. These are obtainable by exporters without charge upon application. By the use of simple change gears lathes may be used to cut metric screw threads and other metric work, and manufacturers of such machinery will equip such lathes with metric lead screws upon request. Furthermore, common sense will cooperate with ingenuity in meeting any exigencies that may arise with efficiency. Never has the pressure been so great from all sides—foreign demands, scientific organization, the urging of the selling end of the business—and never were the facilities for making the change as complete. The difficulties have been greatly overstated, the present opportunity is unique, and must be taken at once if we would get and hold the foreign business of which until now we have merely dreamed.

5. How far should the system be used?

The practical danger in using the metric system is not that we may go too far, but that we shall not go far enough. The "easiest way" may in the end be costly. Merely to price-list products in metric units may be ample in many cases. In others the goods must be packed to the acceptable sizes current in the foreign markets whose trade we seek. In still others, as in the case of drills, measuring tools, gages, etc., the sizes must be strictly metric to meet the needs of the shops in metric countries. Exporting and commission firms have favored the metric system and take advanced ground in this subject. For example, an experienced exporter said recently:

"Every exporter is in favor of the metric system. The exporters are all convinced. The exporters have for 30 years been trying to educate the manufacturer to the necessity of using the metric system."

It must be admitted that the American manufacturer, however progressive in pushing methods of making things for domestic use, has not attacked the foreign-trade problem with his usual resourcefulness. It is doubtful whether manufacturers fully realize the merits of the metric system and what it means for world trade. Under such circumstances, to ask them whether they consider it wise to extend its use in their factories is beginning at the wrong end. The Government should to a great extent take the lead and cooperate with the exporters in educating the manufacturer to the intrinsic merits of the metric system, both because of its scientific perfection and because of its world-wide use. In this respect our manu-

facturers have taken less advanced stands than countries like Sweden, Norway, and Denmark, not to speak of France, Germany, and China.

6. EXTENT OF USE OF THE METRIC SYSTEM

The extent to which the metric system is used in foreign countries is not realized even by well-informed manufacturers. The inclosed summary shows the legal status of the metric system in the countries of the world. A second summary inclosed shows the legal status of the metric system in the United States. Its use in science and medicine is almost world wide.

The significance of this status is enhanced by the fact that China, a country of 400,000,000 people, is now in the process of adopting the metric system. After a world-wide investigation of the subject the weights and measures commission of China reported that the metric system should eventually be adopted. They have therefore this year promulgated the metric system as legal and official, and a transition system based on the metric system as an alternate. The Chinese steel works at Pan Yang (near Hankow, the southern terminus of the Peking-Hankow Railroad) several hundred miles up the Yangtze, was laid out in the metric system, buildings, grounds, and roads being planned and completed in metric units. The rails produced by this plant are also made so many kilograms to the meter and measure so many meters in length. Likewise the great projects for reclaiming the flood districts along the Grand Canal is laid out in the metric system. There is a distinct tendency in this direction.

With the metric system adopted in Europe, Latin America, and China, our isolation with respect to units of weight and measures becomes steadily more complete. Already our liquid and dry measures are unique among the nations of the world, differing even from those of England. It is therefore a most serious question whether we can afford to continue a system out of harmony with the rest of the world. Unification of weights and measures is quite as urgent a matter as the universal systems of longitude and time. Such unification has been accomplished in scientific work the world over, and in 56 countries for other purposes; the latter is sufficient evidence of its feasibility.

Commerce, technology, and science have, on account of their international character, availed themselves of the advantages of the metric system more than manufacturing, which is local, and, unlike exporting, not in direct touch with world markets. Hence science and commerce with their world-wide outlook should be the advisers of industry, and their conclusion is that the first principle is to supply what the customer needs, and that international business requires international weights and measures. An exporter of New York City stated emphatically:

"We shall never have a satisfactory foreign trade until we meet the requirements of the foreign market, one of the principal requirements being the use of metric measures when seeking the trade in metric countries."

7. FAR-REACHING EFFECTS OF THE USE OF THE METRIC SYSTEM

There is a deeper point of view which should not be ignored. In addition to great incidental advantages in the use of the international metric system, such as easier selling, greater satisfaction to buyers, and proximate profits, there are more far-reaching gains which can not be overestimated.

Each industry has had its special units. For decades these have been unifying, not merely within each industry, but all

the industries have been coming to a common standard. At the same time the unification has already taken place in scientific work. The relation between science and industry will become closer and result in the quicker application of new facts discovered by science. The lack of such an intimate relation has been to seriously retard industrial progress. It is a striking fact that the industrial utilization of scientific discoveries made in the laboratory has sometimes taken decades to accomplish. This was true of the gas light, the incandescent light, the arc light, the dynamo, wireless telegraphy, etc. A common system of weights and measures is in a sense a universal language which more closely unites countries in those respects in which their interests are one and the same, namely, the promotion of science, commerce, and industry.

A common system of weights and measures will also aid in realizing one of the aims of the high commission in securing the unification of law and practice. Above all, the effect upon the comity of nations in having a common language of measurement will be to add one more bond of mutual understanding to the forces tending toward permanent international peace.

LEGAL STATUS OF THE INTERNATIONAL METRIC SYSTEM IN THE UNITED STATES

The Congress shall have power to * * * fix the standard of weights and measures. (Constitution of the United States.)

THE METRIC SYSTEM LEGALIZED

It shall be lawful throughout the United States of America to employ the weights and measures of the metric system. (Revised Statutes of the United States, sec. 3569, 1866.)

THE METRIC STANDARDS ADOPTED AS FUNDAMENTAL

The office of weights and measures * * * will in the future regard the international prototype meter and kilogram as fundamental standards in accordance with the act of July 28, 1866. (Order approved by the Secretary of the Treasury, April 5, 1893.)

FOREIGN POSTAL RATES BASED ON METRIC WEIGHTS

The Postmaster General shall furnish to the post office exchanging mails with foreign countries, and to such other offices as he may deem expedient, postal balances denominated in grams of the metric system, 15 grams of which shall be the equivalent, for postal purposes, of one-half ounce avoirdupois, and so on in progression. (Revised Statutes of the United States, sec. 3880.)

METRIC WEIGHTS USED IN THE COINAGE

The weight of the half-dollar shall be twelve grams and one-half of a gram; the quarter-dollar and the dime shall be, respectively, one-half and one-fifth of the weight of said half-dollar. (Revised Statutes of the United States, sec. 3513.)

CONGRESS PROVIDED METRIC STANDARDS FOR THE STATES OF THE UNION

Be it resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be, and he is hereby, authorized

and directed to furnish to each State, to be delivered to the governor thereof, one set of the standard weights and measures of the metric system for the use of the States, respectively. (Joint resolution of Congress approved July 27, 1866.)

UNITED STATES JOINS IN ESTABLISHING INTERNATIONAL BUREAU

The high contracting parties engage to establish and maintain at their common expense a scientific and permanent international bureau[1] of weights and measures, the location of which shall be at Paris. (Extract from convention of 1875, signed for the United States by the United States ambassador to France.)

CONGRESS ADOPTS THE METRIC UNITS FOR ELECTRICAL MEASURES

It was enacted by the Senate and House of Representatives that the international electrical units based on the metric system "shall be the legal units of electrical measure in the United States." (Revised Statutes of the United States, Supplement, vol. 2, chap. 131, 1894.)

METRIC SYSTEM REQUIRED IN THE MEDICAL WORK OF THE NAVY DEPARTMENT

The metric system of weights and measures shall hereafter be employed in the Medical Department of the Navy. (Order approved by the Secretary of the Navy, April 15, 1878.)

METRIC SYSTEM REQUIRED IN MEDICAL WORK OF THE DEPARTMENT

All requisitions, invoices, receipts, and returns pertaining to medical supplies will be in accordance with the metric system of weights and measures. After the 30th day of June, 1894, the use of this system in writing official prescriptions is desired; on and after the 1st day of January, 1895, such use is hereby ordered. (Order approved by Secretary of War, April 13, 1894.)

METRIC SYSTEM RECOGNIZED AND ESTABLISHED IN PORTO RICO

The metric system of weights and measures * * * is recognized and established in Porto Rico for use in all industrial and commercial transactions. (Acts 1913, legislative assembly.)

METRIC SYSTEM MADE THE LEGAL SYSTEM IN THE PHILIPPINE ISLANDS

The metrical system of weights and measures as authorized by sections 3569 and 3570 of the Revised Statutes of the United States and at present in use in the Philippine Islands shall be continued. (Philippine tariff, rev. law 1909; Stat. L. vol. 36, pt. 1, ch. 8, sec. 9, p. 137.)

METRIC SYSTEM REQUIRED IN UNITED STATES PUBLIC HEALTH SERVICE

Officers shall, for all official, medical, and pharmacal purposes, make use of the metric system of weights and measures. In expressing quantities by weight the term of "gram" and

[1] This bureau has the custody of the international standards of the metric system, to which all metric prototypes of the world are referred for verification. It was established and is maintained jointly by all the principal governments of the world.

"kilogram" and in expressing quantity by measure the term "cubic centimeter" only shall be employed. (Regulation promulgated by the President November 21, 1902.)

THE METRIC ADVANCE

[Prepared from official sources by Aubrey Drury, director All-American Standards Council]

POPULATION OF COUNTRIES WHICH HAVE GONE ONTO THE METRIC BASIS IN MERCHANDISING

The figures are the present population of these metric countries, as given in the latest Literary Digest "Atlas of the World." The years, in parentheses, indicate period when legislative enactment instituted metric units for exclusive use in merchandising within these countries—often supplementing earlier laws encouraging the introduction of metric units.

1799–1809		
France (1799)		39,402,000
French colonies, old régime (1799)		901,000
Martinique	193,000	
Guadeloupe	212,000	
St. Pierre	5,000	
French India	268,000	
French Guiana	49,000	
Reunion	174,000	
Total, 1799–1809		40,303,000
1810–1819		
Luxemburg (1816)		263,000
Belgium (1816)		7,478,800
Netherlands (1816)		6,841,000
Dutch colonies in America (1816)		149,000
Curacao	57,000	
Dutch Guiana	92,000	
Total, 1810–1819		14,713,000
1850–1859		
Colombia (1853)		5,855,000
Panama (1853)		401,000
Venezuela (1853)		2,411,000
Ecuador (1856)		2,000,000
Spain (1859)		20,783,000
Cuba (1859—with Spain)		2,889,000
Porto Rico (1859—with Spain)		1,299,000
Canary Islands (1859—with Spain)		506,000
Total, 1850–1859		36,144,000
1860–1869		
Italy (1861)		37,528,000
Portugal (1862)		5,957,000
Portuguese colonies (1862)		8,735,000
Cape Verde Islands, Guinea, St. Thomas, Angola, Mozambique, Portuguese India, Macao.		
Chile (1862–1865)		3,754,000
Peru (1869)		4,569,000
Total, 1860–1869		60,543,000

1870–1879

Germany (1872)	59,857,000
Brazil (1872–1874)	30,635,000
Memel (1872–with Germany)	140,000
Danzig (1872–with Germany)	330,000
Sarre (1872–with Germany)	657,000
Switzerland (1875)	3,880,000
Monaco (about 1875)	23,000
Austria (1876)	6,131,000
Hungary (1875)	7,840,000
Czechoslovakia (1876)	13,595,000
Liechtenstein (1876–with Austria)	10,000
Fiume (1876–with Austria)	49,000
San Marino (about 1870)	12,000
Mauritius (1876)	377,000
Total, 1870–1879	123,536,000

1880–1889

Rumania (1882)	17,393,000
Costa Rica (1884)	476,000
Salvador (1885)	1,500,000
Argentina (1887)	8,553,000
French Oceania (about 1887)	81,000
Sweden (1888)	5,903,000
Norway (1888)	2,646,000
Total, 1880–1889	36,532,000

1890–1899

Bulgaria (1891)	4,861,000
Bolivia (1893)	2,889,000
French Indo-China (about 1892)	16,990,000
Guatemala (1894)	2,119,000
Uruguay (1894)	1,494,000
Nicaragua (about 1895)	638,000
Finland (about 1895)	3,367,000
Tunis (about 1895)	2,093,000
French Africa (about 1895)	20,693,000
Senegal, Niger, Guinea, Ivory Coast, Dahomey, Mauritania, Congo, Mayotte, Somali Coast.	
Madagascar (1896)	3,512,000
Honduras (1897)	637,000
Total, 1890–1899	59,293,000

1906–1909

Paraguay (about 1900)	636,000
Spanish colonies in Africa (about 1900)	1,443,000
Algeria (1902)	5,800,000
Mexico (1905)	15,501,000
Denmark (1907)	3,267,000
Iceland (1907—with Denmark)	94,000
Greenland (1907—with Denmark)	13,000
Faroe Islands (1907—with Denmark)	21,000
Belgian Congo (about 1908)	15,500,000
Philippines (1909)	10,350,000
Total, 1900–1909	52,625,000

1910–1919

Italian Africa (about 1912)	1,421,000
Dominican Republic (1913)	897,000
Syria (French mandate—1919)	3,000,000
Albania (about 1917)	850,000
Total, 1910–1919	6,168,000

1920–1925

Greece (1920)	5,535,000
Poland (1921)	27,778,000
Latvia (1921)	1,503,000
Malta (1921)	224,000
Esthonia (1921)	1,750,000
Russia (1921)	93,387,000
Siberia (1921—with Russia)	10,378,000
Ukrainia (1921—with Russia)	26,001,000
Caucasia (1921—with Russia)	13,500,000
Georgia (1921—with Russia)	2,372,000
Lithuania (1922)	2,671,000
Japan (1921)	56,961,000
Chosen (Korea—with Japan, 1921)	17,284,000
Caroline Islands (1921—with Japan)	39,000
Pelew Islands (1921—with Japan)	4,000
Karafutu (Sakhalin—1921, with Japan)	105,000
Marianne Islands (1921—with Japan)	10,000
Marshall Islands (1921—with Japan)	3,654,000
Taiwan (Formosa—1921, with Japan)	17,000
Haiti (1921)	2,500,000
Siam (1921)	9,121,000
Aden (about 1920)	54,000
Morocco (1923)	6,000,000
Persia (1924)	9,500,000
Netherlands Indies (1925)	49,161,000
Total, 1920–1925	339,509,000
Grand total	769,384,000

It is important to note in addition that China, Turkey, and Egypt have all adopted metric units for official use—and that metric units are employed in those countries to an ever-increasing extent in commerce. In China, for instance, metric units are used on the railroads, in the army, as the official measures of 28 treaty ports, and are predominant in industry and engineering.

With China, Turkey, and Egypt—officially on the metric basis, and destined to employ metric units entirely in the future—added to the 770,000,000 here catalogued, the number of the world's people definitely committed to the metric standards is 1,100,000,000.

The manifest destiny of the metric units is apparent. The decision of the world has been made. Decimal metric units are certain to prevail, while other measures, the relics of bygone ages, disappear.

It is inevitable that the United States of America, leader in decimal currency, shall also adopt the world-uniform decimal weights and measures. Why not now? Aid this metric advance by urging passage of the metric standards bill in the new Congress, placing the United States on the metric basis in merchandising, after a transition period of 10 years.

WHEN WILL THE UNITED STATES ADOPT THE METRIC SYSTEM?

The new economic treaty between Japan and Russia whereby both countries have adopted the decimal metric weights and measures is destined to have a far-reaching effect in foreign trade. This agreement puts all of Europe under a uniform system of weights and measures and thus simplifies a comparison of values in commercial intercourse.

Japan adopted the world decimal standards after a commercial and technical commission of 100 members reported unanimously in favor of it. Russia now has rejected the old measures and is changing as fast as possible over to the metric basis.

The United States stands almost alone, all of the other American nations having in use the metric system. It is a question of only a short time until this country will adopt metric standards, in the opinion of those in close contact with the efforts to induce Congress to bring about this needed reform. There can be no question that the decimal system is much less cumbersome than our standard measures and weights. And it is equally evident that our trade with foreign countries would be simplified greatly if we should adopt the universal standard.

It seems to me the greatest contribution that the French nation has made to human progress, and one for which all the nations of the earth should be grateful to her.

It can not be brought into popular use except by mandatory legislation, persistently enforced, and the burden of proof which justly rests on us as proposing this far-reaching change in national practice has been fully sustained by the experience of more than 100 years.

MEMORANDUM ON BEHALF OF NATIONAL WHOLESALE GROCERS ASSOCIATION

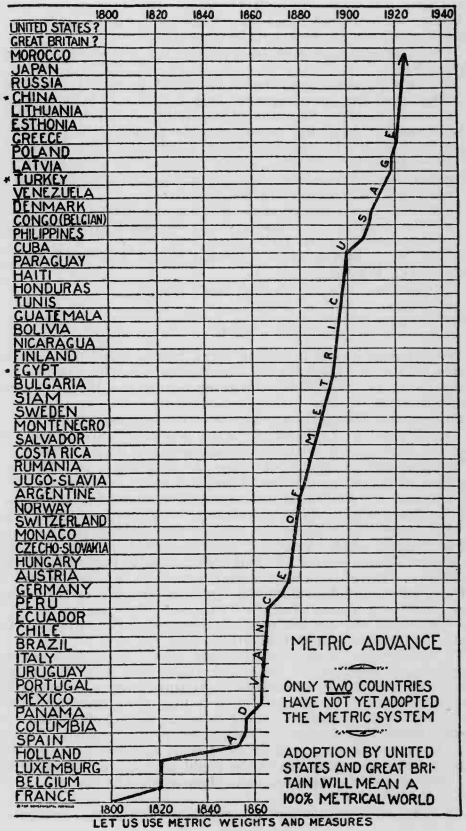
National Wholesale Grocers Association, an organization with members in every State, respectfully urges that favorable action be taken on H. R. 10, which proposes to extend the use of the metric system of weights and measures.

Throughout the country there is a rapidly growing sentiment in favor of the metric system. This sentiment is not confined to the United States, for during the past few years nation after nation officially has adopted the metric system until now but two great powers—Great Britain and the United States—have not adopted it.

In 1866 an act of Congress made the metric system of weights and measures legal in the United States. The system is employed by the War and Navy Departments, the Public Health Service, the Bureau of Standards, and the Bureau of Chemistry of the Department of Agriculture. It was used by the American Expeditionary Forces during the World War.

The United States leads the world in production and commerce, and yet we have failed to advance in connection with a subject closely related to the fields of production and commerce in that we have not as yet adopted the metric system of weights and measures. The adoption of this system would not only facilitate our export trade, but it would make for economy in production and distribution.

For many years the National Wholesale Grocers Association, in the interests of uniformity, simplicity, and economy, has urged the adoption of the metric system, and many members of the association use that system in indicating the weight or measure on labels and cartons.



At the annual meeting of the National Wholesale Grocers Association held at West Baden, Ind., in June, 1925, the following resolution was adopted:

"We favor the simple metric standards for commercial transactions of our great country, which is each year growing more familiar with them through their use in electricity, radio, aviation, and international sports, in addition to their established use in science and certain industries.

"We urge our members to continue the double marking on their labels.

"We advocate the enactment of broad progressive national legislation on this great reform along the lines of bills proposed in the last Congress known as the 'Britten-Ladd' bills."

It is most respectfully urged, therefore, that your committee favorably report to the House of Representatives H. R. 10, introduced by Mr. Britten, which proposes to extend the use of the metric system of weights and measures in merchandising.

New York City, March 1, 1926.

NATIONAL WHOLESALE GROCERS ASSOCIATION OF THE UNITED STATES,
M. L. TOULME,
Secretary, 6 Harrison Street, New York City.

CAMPBELL HOLTON,
Chairman Metric System Committee.

Aubrey Drury, Director, All-America Standards Council, San Francisco, Calif.

The greatest economic opportunity before the United States to-day is in the adoption of the decimal metric weights and measures in merchandising, as proposed by the Britten metric standards bill.

The metric standards are the world's greatest practical success in weights and measures. They are practical because precise and unvarying, uniform throughout the world. They are a monumental success, for since James Watt, in 1783, announced the plan on which the decimal units are based, nation after nation has advanced to the metric measure in merchandising, so that now more than 800,000,000 of the world's people employ these simple, understandable metric measures.

The impracticable clutter of weights and measures to which we of the United States cling at this late date is a relic of barbarism—no nation has ever adopted such a jumble; scores of nations have abandoned similar jumbles for the metric measures. In the words of Andrew Carnegie, "Our present weights and measures are unworthy an intelligent nation to-day. We shall inevitably adopt the metric system."

We hang onto decayed antiques; ours are, indeed, rotten weights and measures. "It is surprising how long the rotten will hang together," commented Thomas Carlyle, "providing you do not handle it roughly." It is high time, therefore, that our enlightened Congress should forever shatter this ball and chain which shackles our progress in commerce, industry, education, household economy, and in all the dealings of daily life. It is time for us to awaken to the rapid progress of standardization throughout the Americas and throughout the world.

Godfrey L. Cabot, president The National Aeronautic Association, Washington, D. C.

I appeared by appointment two separate days at the hearings on the Britten bill and was shut out because the hearings were behind the schedule.

However, I heard some interesting things said by the opponents to the measure, on which I will now comment, and beg that this letter be read to the members of the committee and be made a part of the record.

On my first visit I heard, among other things, a fervid appeal to preserve the Anglo-Saxon system of weights and measures, without which civil liberty never had been established and never could exist.

We have not the English system of weights and measures, but the American system, and it is unlikely that any human being ever has had accurate knowledge of our system.

The very learned and competent men who have prepared the book issued by our Bureau of Standards, and containing a thousand pages of fine print, describing the different measures established by statute, State and Federal, would be obliged to refer many questions to their own compilation before being able to answer them.

Let us take the linear measure: In England that was for many years based on a bronze yardstick, which continuously shrank. Ours, for 60 years, has been based on a certain bar of an alloy containing platinum and iridium on deposit in Paris, which does not shrink. When it was placed there it was the basis for perhaps 5 per cent of the world's population. By sheer merit it has become the basis for the popular weights and measures of 75 per cent of the world's population.

The difference between our linear measure and the English is negligible for ordinary transactions of life, but involves an error ten times as great as the limit of error of the most accurate machine tools.

Let us consider next liquid measure: The English have not the same liquid measure that we have. There are several different gallon measures authorized by law.

Let us pass next to dry measure: Hundreds of different bushels have been established by State statutes in this country, the like of which are not known in England.

We will next consider weight: The English ton, hundredweight, and quarter, in which the bulk of commerce between the two countries is measured, are very different from the same weights as established by statute in this country.

The troy pound has been made illegal in England, though still having a legal status here, and of course all dimensions, both of surface and of cubic contents, are affected by the discrepancy between our yard and the English yard.

I beg now to state that weights and measures have had a very practical bearing on my own activities for many years, and I will bear personal testimony as follows:

I first learned the metric system as a boy and found it incomparably simpler, incomparably more adequate, and easier to learn and apply than the other system that I studied at the same time.

I met with it next as a student of physics and chemistry at Harvard College, where it was the only system that was used in my laboratory work in both sciences, so far as I can recall.

Immediately after graduation I became busied with problems of construction—the building of factories, pipe lines, tanks, water catchers, drips, derricks, etc.

Due to the lack of interchangeability, I had to memorize such facts as that 7.48 gallons make a cubic foot; that 42 gallons make an oil barrel, when it is used as a unit of measure, but that an oil barrel, when it is put on the market, contains anywhere from 48 to 54 gallons, and is billed by the gallon; that linseed oil is billed by the gallon, but weighed as 7½ pounds per gallon, which is far from accurate; that a cubic foot of water weighs about 62½ pounds, of air about 1¼ ounces, and of natural gas three-fourths of an ounce.

With the metric system a liter of water would be identical with the kilogram, a ton of water identical with the cubic meter, and any other substance would be referred to this basis by simply knowing its specific gravity.

I began to acquire real estate, and had to learn that there are 43,560 square feet in an acre, 272¼ square feet in a square rod, etc.

I acquired first and last something over a thousand pieces of realty. Some of it was measured in acres; some in square feet; some in acres and square rods, with vulgar fractions of rods; some in square rods, with decimal fractions of rods and various fractions of acres.

I have never attempted an accurate total of my realty. It would be an almost endless task, whereas with the metric system I should have had only to deal with hectares and decimal fractions thereof, and the addition would be precisely the same as in adding dollars and decimal fractions of a dollar.

Something like 35 years ago I began exporting goods to England, and I immediately had difficulty, due to discrepancy between our weights and English weights of the same name, and from that time to this we have been repeatedly bothered by losses thus arising. To all other countries we used the metric system.

I used the same packages and billed them in kilograms. As the packages were usually uniform in weight in any given shipment, the metric equivalent of the different packages soon became familiar and gave little trouble.

In my export trade I obtained a decided advantage over certain of my competitors by using exclusively the metric system in exports to all non-English countries, even where it was not the popular system; such, for instance, as Denmark and Russia, where it was only adopted years after I had been using it in transactions with those countries.

I never had any objection made by any foreign customer to the use of this system or any intimation that any of them had the slightest difficulty in knowing exactly what they were buying.

A gentleman claiming to represent the United States Manufacturers' Association estimated at $10,000,000,000 the expense of making the needful change. Under the terms of the Britten bill not one of the items of expense that he mentioned would be necessary, for section 3 expressly provides that nothing in the act shall be understood or construed as applying to the construction or use in the arts, manufacture, or industry of any specification, drawing, goods, wares, merchandise, tool, machine, or other appliance or implement designed, manufactured, constructed, or graduated in any system of measurement.

The only material expense that I should be put to in my manufacture would be that of replacing within 10 years my present scales and measuring tapes with scales, measuring tapes, etc., of the metric system, and in this regard a great majority of manufacturers, merchants, and dealers in this country would be on substantially the same basis.

Something was said about threads. By the same token as above indicated, this act changes no threads, and no threads should be changed, but the very men who are opposed to the introduction of the metric system are using in exporting the metric decimal fractions to designate their threads, and there is no material difficulty in so doing whenever and wherever it will promote business.

With regard to the threat that Germany would invade our markets, I call attention to the fact that the Germans are too intelligent to believe that they are not already selling goods

on our system in this country wherever they can thereby gain a customer.

The passage of this measure would be a convenience to the Germans in shipping goods to this country, and to us in shipping goods to Germany.

It would not increase or diminish to a marked degree the export of goods or the import of goods, but it would save an immense amount of human labor therewith connected, and wipe out at one stroke the greatest portion of the disputes and misunderstandings that arise in this connection.

With regard to the plea from the gentleman representing a freight bureau, that this bill would throw an immense burden on the railroads: The railroads are at this moment expending over $100,000,000 a year on the publication of new freight tariffs, and while the expense of repainting the weights on something like 2,000,000 freight cars and the recalculating of tariffs throughout the country would be large in itself, it would be inconsiderable in proportion to the immense saving that would result to the railroads thereafter.

I have a large investment in railroad stock and would be very loath to see any additional burden imposed upon railroads without compensating gain.

I believe that the labor saved in computing bills, etc., would, in the first year, far more than compensate the expense of this change. Think, for instance, of the errors that result from the use of three different kinds of tons in the United States. I only learned yesterday that I was buying my coal by a different ton here in Washington from the one used in Boston, and that coke is sold here by a different ton than coal.

Think of the puzzlement of freight clerks over the hundreds of different kinds of bushels that are in vogue in this country when they are trying to figure with a farmer how much it will cost him to ship his produce to a given market.

I do not think that any man has come before your committee who says that he has used the metric system in his business to any considerable amount and found it less convenient than the other, but you have had a great number of people come before your committee who have used both systems—probably every witness for the Britten bill has used both systems and prefers the metric system.

The engineer for the Westinghouse Co., in answer to my questions, stated that they did not use the metric system in their export business. Inasmuch as the metric system is the only system used in electrical measurements, I conjecture that he had in mind screw threads on the machines that he exported; but if the Westinghouse people are not billing their goods to Europe in kilograms and describing them in metric units they ought to get some person of ordinary intelligence to take over and revamp their export business, for they are losing a good many tricks.

The National Aeronautic Association is greatly annoyed by the American system of measures, and it would greatly facilitate our business if it were abolished and the metric system used.

I am also president of the Salem Gasoline Co., of the Godfrey L. Cabot (Inc.), of the National Gas Products Association, and chairman of the board of trustees of the United Carbon Co.; I control the Monarch Carbon Co., the Kanawha Valley Products Co., the Wak Co., the Texas Elf Co., and the Cabot Co. of Texas. I am director of the Standard Carbon Co., of the Gas Products Co. of Montana, and I believe that the adoption of the metric system would materially facilitate the business of all these corporations and associations and would

entail no considerable expense beyond the replacing during 10 years of our scales and measures by metric scales and measures.

One of the opponents to the bill referred to the fact that pipes are not described by the metric system. Quite true; and I would make no change in that regard, nor would I make any change in standard threads of any kind, sort, or description.

The decimal system is not a fetish that I worship; it is a convenience in trade, and wherever in any detail it would not facilitate trade I would leave present conditions undisturbed.

I have no quarrel with the divisions of time, which originated in Mesopotamia and are now in use throughout the world. The Britten bill makes no change that is not a salutary change; we are simply proposing to travel the path that has been traveled with advantage by nearly every other nation in the world.

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